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WHITE CLAY DEPOSITS AT SAYLORSBURG, MONROE COUNTY, PENNSYLVANIA

By

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Introduction. This paper is the result of field work done under the direction of former State Geologist, Richard H. Hice, in the summer of 1919 in an effort to develop further one of Monroe County's mineral industries.

During the World War the usual importations of white clay from Europe were greatly reduced. It was the purpose of Federal and State Surveys to encourage home production in every practical way, and this study of a clay deposit, it was hoped might aid in developing our native white clay industry to the point of making the country more nearly independent of foreign supply.

Use. White clay is used for a variety of purposes including the manufacture of paper, muslin, porcelain, electric insulators and spark plugs, white cement, glass pots, graphite crucibles, pottery, calcamine and water paint.

The use of white clay in crucibles for the manufacture of certain kinds of steel, and in porcelain where high electrical resistance is required, make this mineral a war necessity. Its principal use at present is in the manufacture of white cement and as filler in paper.

Location and history of development. The white clay deposits in the vicinity of Saylorsburg, Monroe County, are on the north side of Cherry Ridge and of Chestnut Ridge. Saylorsburg is 4 miles northwest of Pen Argyl and is reached by a branch of the Lehigh and New England Railroad.

The exploitation of the white clay near Saylorsburg began in 1891 when Oscar Drehr built a plant and made an unsuccessful attempt to use the clay for the manufacture of enamel brick. About three years later, the plant was taken over by Blanchard Brothers of Newark, N. J., who started the manufacture of dry pressed brick. This plant was operated with varying success under different managements for several years. It has been owned and operated by the Keystone Clay and Reduction Company since 1908 for the production of washed clay.

In 1909 the Atlas Portland Cement Co. purchased a tract on the north slope of Cherry Ridge, one mile northeast of Saylorsburg and has been mining white clay more or less continuously for use in the manufacture of white portland cement in their plant at Northampton on Lehigh River.

About 1917 the Mt. Eaton Clay Co. began sinking a shaft and developing a plant 1½ miles southwest of Saylorsburg. This is the latest development,

Stratigraphy. The formations exposed within a few miles include the Martinsburg shale or slate of Ordovician age (at Pen Argyl); Medina sandstone of Silurian age, forming Blue Mountain; High Falls (Clinton) red sandstone and shale in Blue Mountain and the valley on the north; Poxono Island shales on the south side of Cherry Ridge and Chestnut Ridge; Bossardsville limestone on the flanks of these ridges; limestone and shaly beds above the Bossardsville formation, and Oriskany sandstone in the tops of these ridges.

The Bossardsville and overlying limestones are the most important geological units in this connection, the Bossardsville because it is the guide rock to the white clay deposits. It appears to be approximately 90 feet thick and is easily identified by its thin banded, ribbony appearance and by the numerous quarries in it.

The overlying limestone beds include over 200 feet of sediments between the Bossardsville limestone and Oriskany sandstone. They are mostly impure limestone and shale and it was the alteration of these rocks that furnished practically all of the white clay deposits. The beds are poorly exposed in this vicinity but the following formations have been recognized: Oriskany sandstone, Port Ewen limestone, Becraft limestone, New Scotland limestone and shales, Coeymans limestone, Manlius limestone, Rondout limestone and shales, Decker's Ferry limestone, Bossardsville limestone.

Structure. The rocks in Blue Mountain, Cherry Ridge, and westward are folded into northeast-trending anticlines and synclines so characteristic of the mountain belt through central Pennsylvania. Cherry Ridge is a synclinal structure, with Bossardsville limestone dipping in to the ridge from both sides, and Oriskany sandstone lying along the axis of the basin forms the crest of the ridge. Chestnut Ridge is a continuation of the syncline but an anticline close on the west carries the Oriskany sandstone over and down the western slope so that the Bossardsville and overlying limestone formations are concealed by it. The facts seem to indicate that the

axis of this anticline follows the northern slope of Chestnut and Cherry Ridges from Kunkletown to Saylorsburg and lies between the 750 and 850 foot contours. All the clay thus far developed in the Saylorsburg region has been found near the summit of this anticline.

Origin. The explanation of the white clay deposits has not been definitely determined. It seems certain, however, that the constant percolation of surface water into the clay-forming rocks must have had a leaching effect on them, and so have been a factor in their transformation into clay. The spotty character of the clay deposits may be explained by differences in the original character of the rock or by amount of fracturing. The derivation of the clay by the alteration of sedimentary strata in situ is evident when the deposits are examined in the mines.

Description of Mines. For 30 years the clay mines in the vicinity of Saylorsburg have been in operation. About 20 important openings have been made in the clay beds along the northern slope of Cherry Ridge within 1½ miles of Saylorsburg. Unlike common clay pits at brickyards, the white clay mines are underground workings from shafts. The clay is mined by the caving system. Timbering of course is necessary. Water is troublesome in some of the mines, especially in the rainy seasons in that it softens the clay and causes it to flow. There are three principal properties, those of the Keystone Clay and Reduction Co., Atlas Portland Cement Co., and the Pennsylvania White Clay Mining Co., formerly the Mt. Eaton Clay Company.

Keystone Clay and Reduction Co. The pioneer clay producer near Saylorsburg was the company organized by Mr. Oscar Drehr. After changing hands several times the property finally came into possession of the Keystone Clay and Reduction Co.

The property lies on both sides of the road in the gap at Saylorsburg and contains nine shafts, the deepest of which is 116 feet. The westernmost and deepest shaft has two crosscuts to the south, an upper one at the 85 foot level about 40 feet long, and a lower one 60 feet long at the 110 foot level. The lower one struck the hard sandstone hanging wall dipping south about 70° but found the white clay bed thin.

Between this shaft and the road is another shaft 80 feet deep with two crosscuts, one 60 feet long and 67 feet in depth, and another 100 feet long at the bottom of the shaft. Against the south dipping hanging wall is 6 feet of colored clay with irregular discontinuous bands of gray flint, called "spar" by the miners. Next to or under the "spar" vein is 8 to 20 feet of white clay.

In the crosscut at the foot of a 47-foot shaft just east of the village three varieties of clay occur: (1) Black clay at the bottom of the shaft, (2) gray, sandy, iron-stained clay, No. 2 grade, 42 feet thick, (3) good white clay of No. 1 grade, 8 to 26 feet thick.

From 50 to 60 tons of clay were being hoisted daily from this shaft at the time of inspection (1919) of which 40 tons were of the

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No. 1 variety, and 20 tons of the No. 2 grade. Although two grades of clay are mined, they are mixed in the washing process, and only one grade of the finished product is sold.

The crude clay from this mine is washed to free it from fine sand. From the daily output of 50 tons, about 30 tons of finished clay is derived.

In order to free the clay from this sand which is so fine as to resemble clay itself, the following process has been developed. The crude clay is mixed with water in a pug-mill of special design. From the pug-mill it issues with a milky consistency and passes to a trough about 8 inches wide, into which trickles a small stream of caustic soda solution. The solution is made by dissolving 37½ pounds of caustic soda in 50 gallons of water. This amount of solution will treat about 25 tons of crude clay. The caustic soda solution has the effect of separating the particles of clay from each other, and the process is known as "defloculation." This separates the clay from the sand particles and makes it possible to secure a purer grade of clay. From the narrow trough the creamy liquid passes to a large settling tank where the coarsest of the sand is allowed to settle. From this tank it goes to a series of troughs, with flat bottoms, that successively widen. This device causes the water to flow more and more slowly, which allows the very finest of the silica or sand to settle, the defloculated clay still remaining in suspension. Baffle boards placed across the troughs aid in the separation and keep the slip (the technical term applied to the mixture) agitated. The water, with little but fine clay in suspension, next passes into large settling tanks where alum is added to "floculate" the clay and cause it to settle. As the clay settles the clear water is drawn off at the top leaving a slip of creamy or muddy consistency which is pumped into filter presses under a pressure of about 125 pounds per square inch. The cakes of wet clay from the presses are passed to dryers where practically all of the uncombined water is driven off. The cakes are then pulverized and the finished material sold for various purposes.

Most of the product of this plant is used in New England in the manufacture of paper. Some of it is used in the manufacture of automobile tires and water paints. The total annual production approximates 7500 tons.

Atlas Portland Cement Co. The property of this company is located one mile northeast of Saylorsburg on the road to Bossardsville. The company, it is said, owns a tract of 105 acres of land, which extends from the highway southward to the crest of Cherry Ridge.

There are 8 or 10 shafts on this property. The one being worked when the property was visited is 102 feet deep, and has two levels. About 45 feet from the top of the shaft is a crosscut to the southeast, approximately 100 feet in length, all the way in clays of various sorts. The end of this crosscut is in a 20 foot bed of good white clay. About half way from the shaft to the end of it a drift has been driven 200 feet southwest and 100 feet northeast. This drift is in gray clay.

The more important developments in this mine are on a lower level, 90 feet from the top of the shaft. Here a crosscut having a general southeasterly direction, traverses a variety of clay beds very nearly at right angles to their strike, and terminates about 150 feet from the shaft against a well-defined hanging wall of hard, gritty sandstone, called "ganister." This is probably the Oriskany sandstone. The thickness of this sandstone is not known, for it has nowhere been penetrated. It strikes about N. 65°-70° E and dips south 70°.

At the foot of the shaft are beds of brown sandy clay of undetermined thickness that dip S 65°. Next comes gray sandy clay beds with some "spar", approximately 50 feet thick. They are followed by a 10 foot bed of gray clay with an abundance of gray flint in irregular nodules arranged in indistinct bands. Still farther from the shaft and resting on this "spar vein", is 30 to 50 feet of gray sandy clay and 10 feet of black clay. This black clay can be traced through all the workings on this level. Its dark color is caused by a high percentage of carbon. Above the black clay toward the end of the crosscut comes a 10-foot bed of No. 2 gray clay, and 15 to 26 feet of No. 1 white clay. These two beds are being mined. The white clay is in contact with hard sandstone.

Essentially the same sequence of clay beds is revealed by drifts on this level, one of which is 200 feet long.

It is clear that these beds of clay lie but a short distance, if not immediately below the Oriskany sandstone, that forms the crest of Cherry Ridge to the south. Furthermore, if we are to regard these clay beds as the altered product of impure clayey and sandy limestones, and of calcareous shales, similar in their chemical and lithological characters to the Stormville beds, then the rather striking resemblance in the character, thickness and sequence of the clay beds to the Stormville beds as exposed in the section along the New York, Susquehanna & Western Railroad north of the Delaware Water Gap, becomes clear. By an alteration of the more or less impure clayey limestones, the white or gray clays would result. By an alteration of the ashy gray calcareous and sandy shales, the sandy, gray beds would be formed. The alteration of the black shales, or impure black limestones, would result in the formation of the black carbonaceous clay beds. Likewise, the alteration of the flint-bearing limestones would form the "spar seams" or flint-bearing clay beds. All of this metamorphosis would be simply and easily accomplished by the leaching out of the lime, leaving behind the insoluble clayey and sandy residue. Such at any rate is the explanation here offered.

Mt. Eaton Clay Co. The property of the company, 36 acres in extent, is 1½ miles southwest of Saylorsburg on the north slope of Chestnut Ridge. The mine shaft 100 feet deep was sunk most of the way in sandy clay containing much gray flint. Four feet of excellent white porcelain clay is reported at a depth of 40 feet. A 200 foot crosscut driven southeast at the 85 foot level passes through various kinds of clay and terminates against a hanging wall of hard gritty sandstone, probably the Oriskany, that strikes N 65° E and dips S 65°.

Starting at the shaft the crosscut passes through 50 feet of gray sandy clay with occasional streaks of flint, then a 10-foot bed of good gray clay, followed by 60 feet of gray sandy clay containing streaks of flint or "spar." Next comes a 6-foot bed of good white clay and 6 feet of clay with considerable flint. These two thin beds are followed by 15 to 18 feet of No. 1 white clay which is mined by drifts in both directions along the strike. Between the white clay and the sandstone hanging wall is 51 feet of gray clay of uniform character with red and pink iron stains.

It will be noted that the workable beds of white clay are not next to the hanging wall, as in the Atlas mine, but are 50 feet from it. On the whole there is much similarity between the clays of the Mt. Eaton and Atlas mines, except that black clay bands are absent in the former.

Analyses of clay from Mt. Eaton mine, Saylorsburg, Pa.

(Paessler, Heller and Jacoby, Wilkes-Barre, analysts)

	No. 1 per cent	No. 2 per cent
Silica (SiO_2)	69.85	67.89
Alumina (Al_2O_3)	22.53	21.57
Iron (Fe_2O_3)	1.23	1.60
Calcium (CaO)	1.17	0.78
Magnesium (MgO)	0.35	0.50
Alkalies (Na_2O,K_2O)	1.06	1.00
Titanic acid (TiO_2)		1.90
Moisture and undetermined	-3.90	4.76
	100.09	100.00

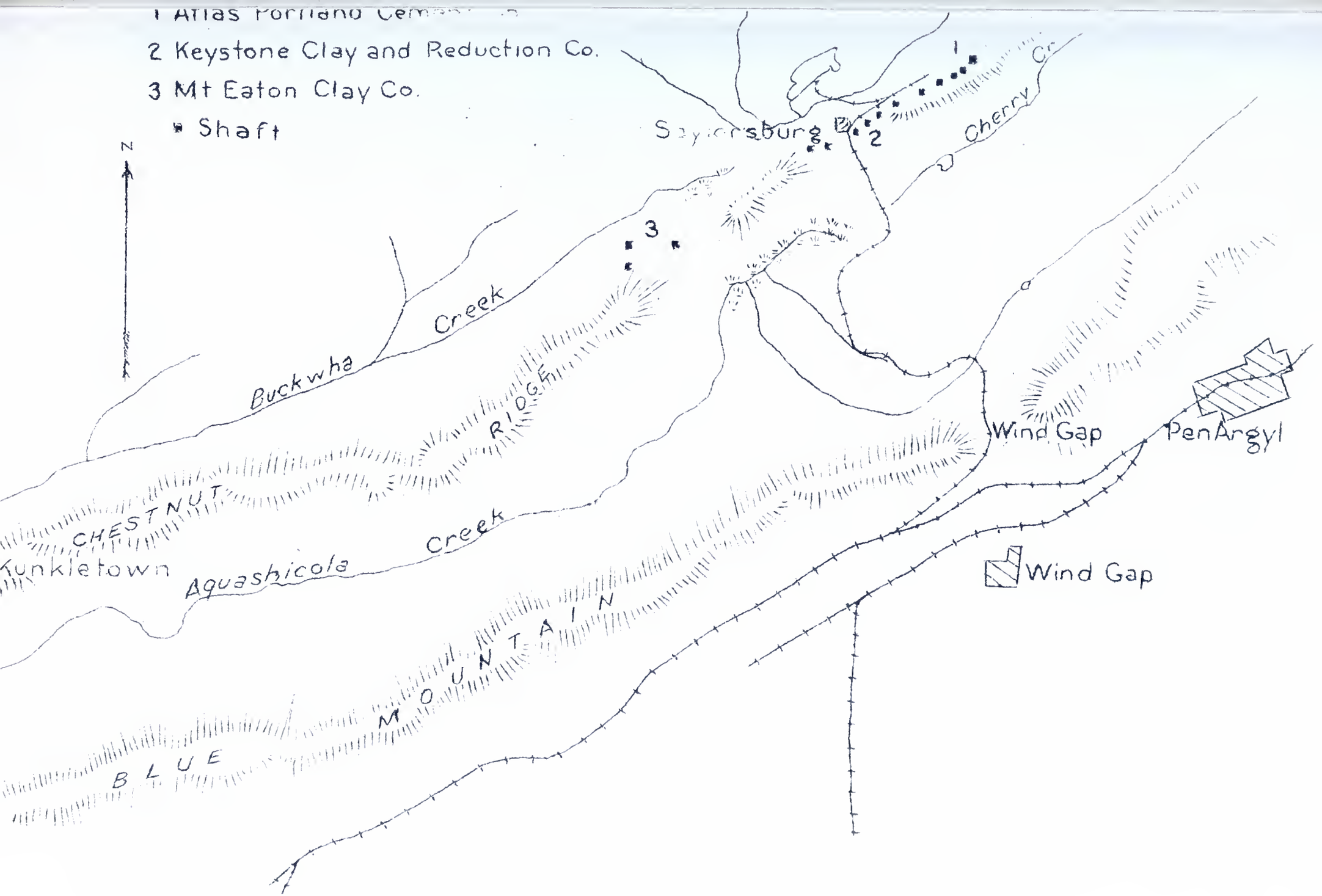
Prospecting. Persons prospecting for clay in the future would do well to confine their efforts to the northern slopes of these ridges, particularly northeast and southwest of the Mt. Eaton property, at an elevation of about 800 feet. Between the Mt. Eaton property and Saylorsburg lies a particularly attractive field for prospecting. For 4 or 5 miles east of Kunkletown on the north side of Chestnut Ridge the Oriskany sandstone apparently has not been eroded; the underlying Stormville beds therefore have not been subjected to leaching, and deposits of white clay may not be found here.

Recent developments. The following notes are furnished by D. F. Chamberlain, of Lehigh University:

The status of the clay mining operations at Saylorsburg on May 1, 1922, shows a radical change over conditions in 1919. The Atlas Portland Cement Co. mines a clay that is considerably stained. It is understood that this company is prospecting the whole region for a new supply, as the original supply is nearly exhausted.

The Keystone Clay and Reduction Company has ceased operations, with the possible exception of the occasional washing of a small quantity of clay.

The Mt. Eaton Clay Company, now operating as the Pennsylvania White Clay Mining Company, has sunk two new shafts southwest of the old workings. These shafts run to a 60 foot level, one shaft having a drift 100 feet west with crosscuts at intervals. The drifts are substantially timbered so that mining may be continued indefinitely. There is very little trouble from water, and pumping is required only occasionally during the spring thaws and rains. This company is mining about 50 tons daily. All grades of clay are combined, passed through a disintegrator, dried in a rotary kiln, then ground to 15 mesh and finer. This product is sold as a semi-refractory material for foundry, blast furnace and general metallurgical practice. It has properties that are more desirable than some of the higher refractory clays. Clay washing has been abandoned for the time as the method of flotation above described yielded only 25 per cent of clay suitable for paper making.



WHITE CLAY MINES NEAR SAYLORSBURG, MONROE COUNTY

2 3 MILES